

## N-Rich Reference Zone Case Study: Sacramento County 2020-21

Michelle Leinfelder-Miles, Taylor Nelsen, Mark Lundy

We implemented nitrogen-rich (N-rich) reference zones on a 40-acre wheat field in the Sacramento County Delta where the seasonal ranch average grain yield and protein were approximately 6800 lb/ac and 11%, respectively. The ranch average yield was approximately 1000 lb higher than the historical average and about 300 lb higher than last year. The 2020-21 season has been characterized as one of the driest winters on record, and this ranch tends to yield higher in dry years. The cumulative rainfall at this site was approximately 6.2 in, compared to a 14-in historical average.

### N-rich reference zone creation:

The soil at this field is characterized as a Rindge mucky silt loam. The Rindge series ranges from 10 to 65% organic matter down to the 60-in depth. The grower's pre-plant UN-32 application provided approximately 60 lb/ac N, and the wheat was planted on 11/13/20. The grower usually applies aqua ammonia instead of UN-32, but UN-32 was cheaper this year. We soil sampled from the top 0-12 in on 11/20/20, and performed a [soil nitrate quick test](#) (SNQT). The soil contained approximately 67 lb/ac nitrate-N ( $\pm 27$  lb/ac nitrate-N). We flagged off three N-rich reference zones. Each zone was 90 ft by 180 ft. On 12/11/20, we broadcasted urea to the N-rich zones at a rate of approximately 60 lb/ac N. We timed our application ahead of a storm that resulted in 1 in of rainfall.

### Early season conditions:

On 1/25/21 (2-4 tillers), we took soil and [canopy measurements](#). Prior to this sampling, a canal had backed up and flooded the bottom end of the field, including one of the three N-rich zones. Consequently, the soil nitrate-N was lower at the bottom end of the field, but there were no differences in canopy reflectance between the N-rich zones and field rate for any replicate.

### Plant and soil measurements:

On 2/16/21 (tillering to one node), variability down the field was evident in canopy reflectance (Figure 1), but the grower indicated that he would not make

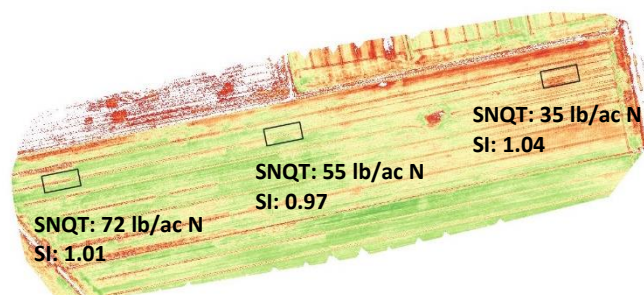


Figure 1. Drone imagery taken on 2/16/21, when the field was tillering to 1 node (i.e. Feekes 6). The imagery shows field variability from the top of the field (left side of the image) to the bottom of the field, where flooding occurred earlier in the season. Black polygons represent the N-rich zones. SNQT and SI values are shown for each replicate. SNQT values are an approximation of available N.

## SITE INFORMATION

**Location:** Sacramento County

**Soil type:** Rindge mucky silt loam

**Previous crop:** Corn

**Variety:** WestBred 9699

**Seeding method:** Grain drill, 2-in depth

**Seeding rate:** 150 lb/ac

**Planting date:** 11/13/20

**Bedded:** No

## PRE-PLANT N MANAGEMENT

**Field rate:** 60 lb/ac of UN-32

**N-rich zone:** 120 lb/ac

N fertilization decisions based on the low end of the field where flooding had occurred. The sufficiency index (SI) calculation and [The Nitrogen Fertilizer Management Tool for California Wheat](#) indicated that the field would not benefit from topdressing with N. SI values less than 0.97 indicate possible crop N deficiency, and values less than 0.93 indicate likely crop N deficiency. Likewise, there was no indication of field response to topdressing based on 3/14/21 (2 nodes) measurements.

#### Fertilizer recommendations and in-season management actions:

Since monitoring data did not indicate a benefit from topdressing, and with no rain in the forecast, the grower decided not to apply additional N this season. We decided to apply small topdress zones outside the N-rich zones in order to measure whether a topdress would have benefitted yield or protein. On 3/14/21, we applied 40 lb/ac N as urea to zones ahead of 0.45 in of rain. We monitored satellite imagery (Figure 2) and leaf chlorophyll on 4/6/21 when approximately 72% of the annual crop N uptake had occurred, and we concluded that the crop was unlikely to respond to in-season N fertilizer.

#### End of season results:

The field was harvested on 6/14/21. We hand-harvested from the N-rich zones, topdress zones, and surrounding field, and there were no differences among them for yield ( $p = 0.65$ ). The lower end of the field yielded lower than the middle and upper sections. For protein, there was no statistical difference between the field and the N-rich zones, but the topdress improved protein by about 0.5% ( $p = 0.07$ ). We estimate that N uptake (including straw) was approximately 163 lb/ac N in the field, 172 lb/ac N in the N-rich zones, and 175 lb/ac N in the topdress zones.

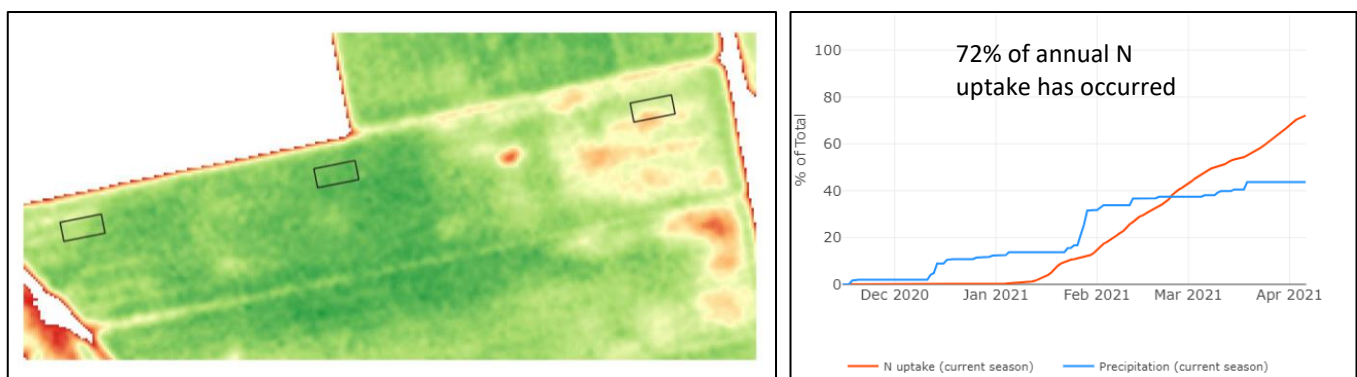


Figure 2. Satellite imagery taken on 4/6/21, when the field was heading (i.e. Feekes 10.1). Black polygons represent the N-rich zones. The graphed output from the [webtool](#) showed an estimated 72% of the crop N uptake had occurred by this date. Due to field variability, no clear indication from the online tool, and no rain in the forecast, the grower decided not to apply in-season N fertilizer.

#### OUTCOMES:

- In-season N fertilizer application recommended? No
- In-season N fertilizer applied? No
- Yield
  - 6800 lb/ac (ranch average)
  - 1000 lb/ac higher than historical average
- Protein
  - 11% (ranch average)
  - 1% higher than historical average
- Crop N uptake for the field
  - 163 lb/ac
- Total N fertilizer applied
  - Pre-season: 60 lb/ac
  - In-season: 0 lb/ac

We thank Dennis Lewallen for his collaboration and insights.